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WINDBREAKS

NATURAL HISTORY SURVEY

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for Illinois Farmsteads · J. E. Davis

Circular 38

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In Cooperation With
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STATE OF ILLINOIS
William G. Stratton, Governor
DEPARTMENT OF REGISTRATION AND EDUCATION
Vera M. Binks, Director

WINDBREAKS
for Illinois Farmsteads

J. E. DAVIS

Printed by Authority of the State of Illinois

NATURAL HISTORY SURVEY DIVISION
Harlow B. Mills, Chief

Circular 38

(Fifth Printing, With Revisions by L. B. Culver)

Urbana February 1954

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This paper is a contribution from the Section of Forestry.

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Photographs for figs. 6 and 7 from Claude Thorp and Son, Wapella; for fig. 22 from Ray T. Nicholas, Lake County Farm Adviser, Grayslake, Illinois.

The greatest benefit that can be expected from a good windbreak is the sheltering effect on the farmhouse, the farm buildings, and the feedlots. With its contribution of beauty and color, as well as comfort, the windbreak can make a farm home out of a farmhouse. The 14-year-old Norway spruce windbreak illustrated here is in Livingston County.

WINDBREAKS . J. E. DAVIS*

for Illinois Farmsteads

WINDBREAK, as commonly understood in Illinois, is the name given to a narrow belt of trees planted on one or more sides of a farmstead to provide protection from the wind.

NEED FOR WINDBREAKS

In Illinois, with only a tenth of the state occupied by forest growth, which is irregularly distributed, there is a strong need for evergreen plantings to protect farmsteads from cold northwest winds that blow in winter. This need is felt particularly in sections of intensive agriculture, both in originally timbered sections and on the prairies, where differences in elevation are not sufficient to break the force of the wind. From 1870 to 1875, considerable interest in windbreak planting was evidenced in the northern part of the state, and the early plantings that were given good care and protection now stand as landmarks, the better evergreen windbreaks having reached heights of 60 feet and more.

The trees used in early windbreaks were mostly of European origin, and it was not always easy to obtain good planting stock. Today, with numerous private tree nurseries in the state producing comparatively large quantities of trees suited to windbreak planting, farm people can easily provide themselves with wind protection at reasonable cost.

BENEFITS FROM WINDBREAKS

The greatest benefit that can be expected from a good windbreak is the sheltering effect on the farmhouse, the farm buildings, and the feedlots, fig. 1. A house protected by a windbreak is more comfortable in winter, and less costly to heat, than one lacking such protection. Windbreak-protected barns and feed sheds are warmer in winter and keep more nearly even tempera-

*Formerly Extension Forester, Illinois Natural History Survey and University of Illinois College of Agriculture, cooperating. Revisions in the present edition of this circular are by L. B. Culver, successor to Mr. Davis.

tures, so that livestock can be more easily carried over winter in good condition. Also, livestock can make more winter use of protected feedlots. For men working around feedlots and barns, or for women hanging out clothes, the windbreak provides com-

Fig. 1.—Farmstead facing south in southeastern Henry County. Upper: Protective strips of trees are on the north and west sides. Lower: Feed shed and feedlots of this farmstead are well protected by a 28-year-old windbreak of Norway spruce.

parative comfort in the zone of quiet air to the leeward of its spreading branches. The windbreak also catches snow, and if properly located it prevents blocking of walks and drives, and drifting around buildings. Snow in the shade of the trees melts slowly in the spring, and the moisture is conserved for garden crops and small fruits planted near the windbreak.

With its contribution of beautiful form and color, as well as comfort, the windbreak can make a farm home out of a farmhouse. While protecting the farm buildings, the windbreak also protects near-by flowers, shrubs, and ornamental trees, giving them a better chance to develop and beautify the home grounds. The windbreak may well serve as background for conveniently arranged farm buildings enriched by well-chosen trees and shrubs, the whole of which makes the farm home attractive.

EXPECTATIONS

Under average conditions the evergreen trees recommended for windbreaks grow at moderate rates, figs. 2, 3, and 26. Trees in a Norway spruce windbreak planted near Greenville in Bond County averaged 18 feet in height in 12 years. Another Norway spruce windbreak planted in the southeastern corner of Hamilton County reached a height of 30 feet at 18 years of age; its branches now form an almost impenetrable barrier to the wind. In northern Rock Island County another Norway spruce windbreak at 28 years attained a height of 38 feet, fig. 4. Evergreen windbreaks planted in northern Illinois 70 years ago now stand 60 to 70 feet high and have been affording good protection for more than 50 years. Patience and attention to details in caring for an evergreen windbreak will be well rewarded, for its protective influence will last several generations.

Fig. 2.—This farmstead in Jo Daviess County enjoys the protection of a 60-year-old Norway spruce windbreak.

Fig. 3.—A Norway spruce windbreak in McLean County. Protected from stock and poultry by a good fence, the trees in this windbreak in 18 years reached a height of 20 feet.

Most of the windbreak trees may be expected to increase in height an average of 1 foot per year throughout their lives. For the first 20 years some trees may grow as much as 3 feet a year, variations in growth depending on seasons, soil and moisture

Fig. 4.—This 28-year-old windbreak of Norway spruce in Rock Island County stands as a bulwark against winter storms. In summer it serves as an area for studying birds that find a haven there. The trees, spaced 16 feet apart in and between the three rows, average 38 feet in height.

conditions, and care. On the Grand Prairie, none of the evergreens should be expected to make as good height growth or to maintain as dense foliage as they do in other sections of the state. In this area, Norway spruce exceeds the pines in height and it does not flatten out as do the pines.

Some persons who are not well acquainted with evergreen trees and their rates of growth would rather plant Chinese elm, Lombardy poplar, or soft maple to make a showing more quickly. Although their growth is rapid, these species do not make satisfactory windbreaks or even good, permanent shade. Because their wood is weak, they are subject to ice and wind damage. Lacking foliage during winter months, they fail to furnish protection when it is most needed.

PLANNING THE WINDBREAK

Locating the Windbreak.—Weather records show that, for most of Illinois, prevailing winter winds are from northwesterly directions, fig. 5; therefore, the windbreak, to give the best protection, in most cases should be located on the north and

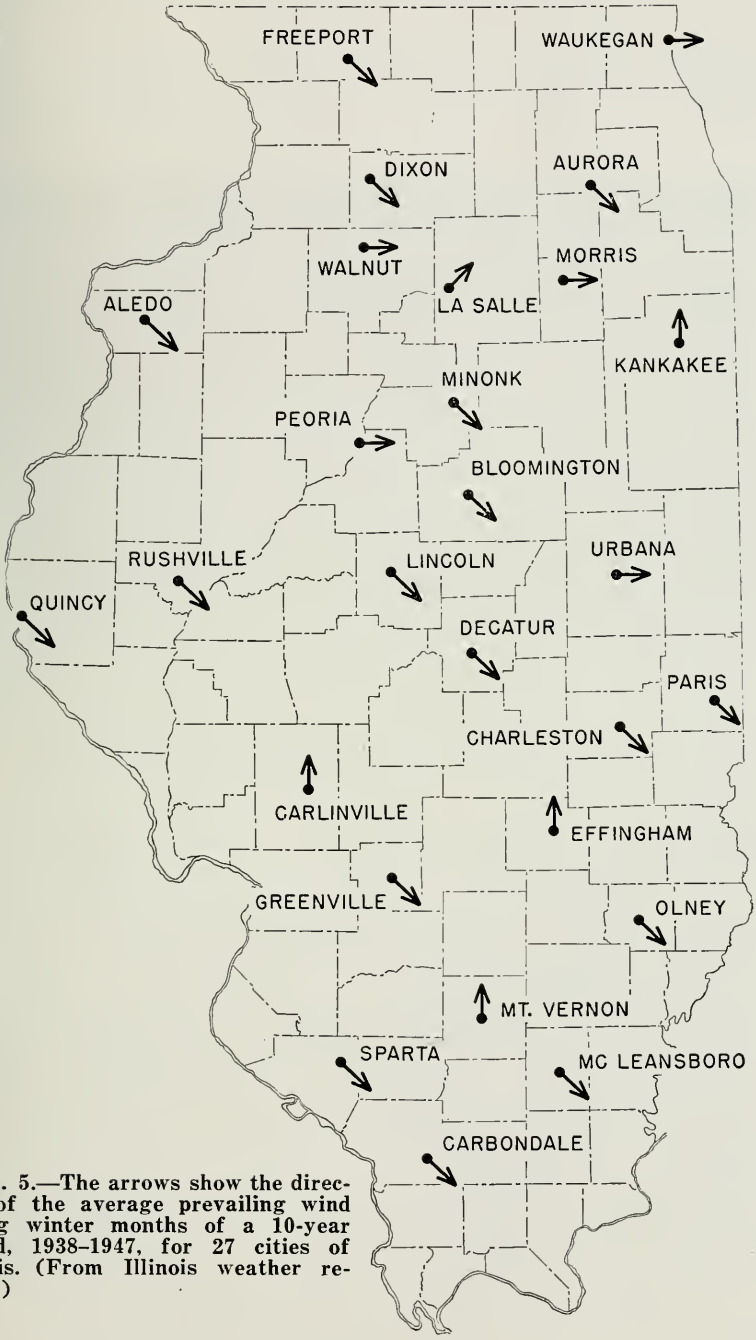

Fig. 5.—The arrows show the direction of the average prevailing wind during winter months of a 10-year period, 1938–1947, for 27 cities of Illinois. (From Illinois weather reports.)

west sides of the farmstead, figs. 6 and 7. Even in those localities in which the prevailing wind is southerly, it is not advisable to place a windbreak south of the farmstead. In such localities the coldest winds are generally from the north and

Fig. 6.—A Norway spruce windbreak on the prairie in De Witt County 3 years after being planted along the north and west sides of a farmstead. Because of the size and shape of the farmstead area, 200 trees were required. The average farmstead requires between 100 and 150 trees.

Fig. 7.—The windbreak shown in fig. 6 at 9 years of age. With the trees averaging 15 feet in height, the planting is already giving some protection.

northwest. Also, the prevailing summer winds are southwest, and it is desirable to have the farmstead exposed on the south to receive the cooling effects of these winds. In localities where the prevailing winter wind is south or southwest, it is advisable to run the north-south line of the windbreak at least 100 feet farther than usual to the south of the farm buildings.

The most effective and most easily arranged windbreak is in the form of an L, fig. 8, with the point to the northwest. The

Fig. 8.—An L-shaped windbreak in McHenry County shortly after being planted in 1938. This arrangement is most effective in protecting farmsteads from prevailing winds.

legs of the L may be broken to make way for farm lanes, but the windbreak should not be broken near the point, where northwest winds may sweep through directly to the buildings.

Figs. 9 and 10 show windbreak plans for farmsteads facing the cardinal points of the compass. These plans are for typical farmsteads found in Illinois and are set up only as guides for the prospective windbreak planter. Because of the unlimited ways in which farm buildings are arranged, nearly every farmstead presents a different problem in the planning of the windbreak. If the principles recommended in this circular are followed in planning the windbreak, it should be possible to provide satisfactory protection for any type of farmstead arrangement.

Farmsteads facing south or east, fig. 9, are the easiest for which to plan windbreaks. Those facing west or north, fig. 10,

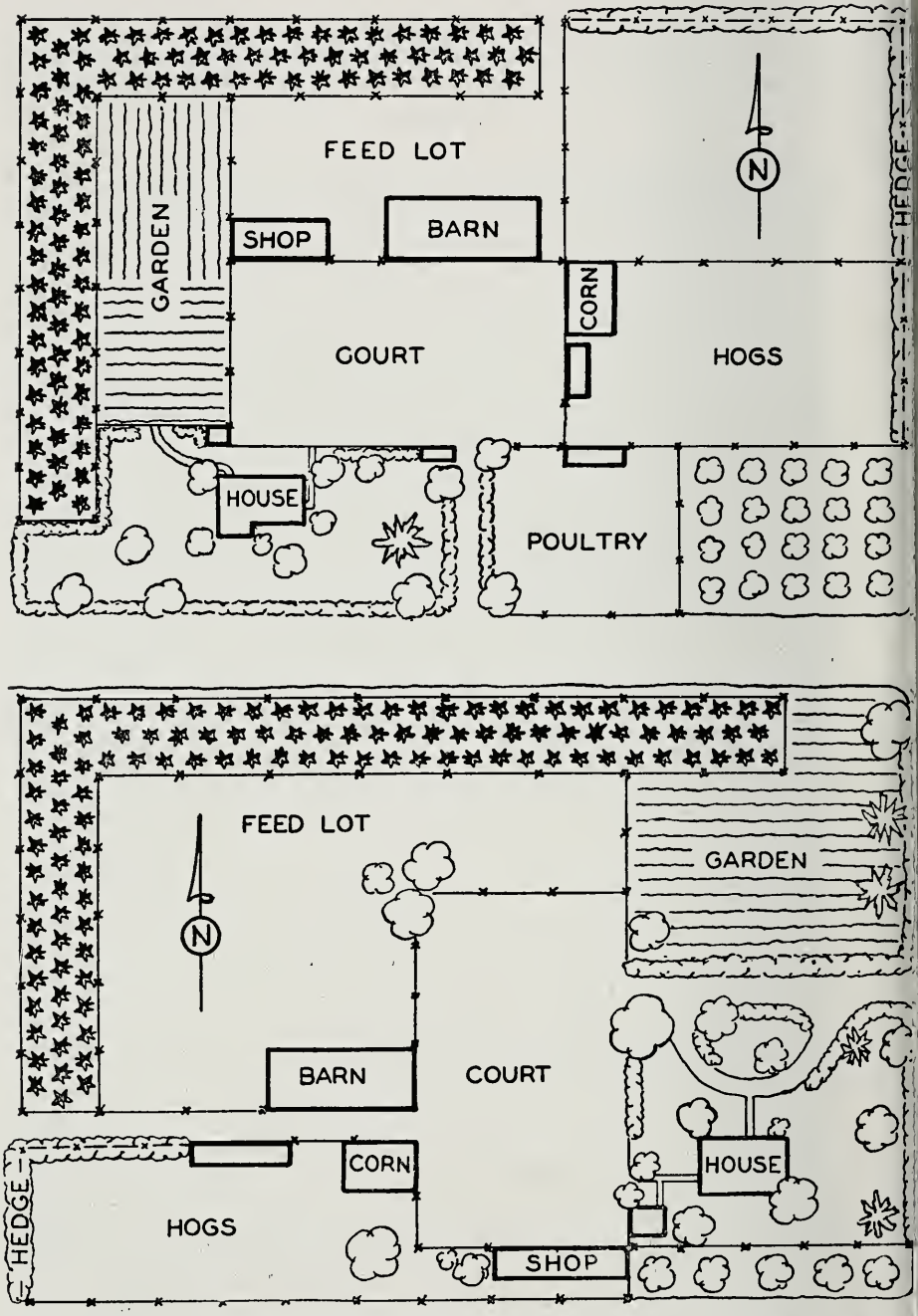

Fig 9.—Plan for windbreak on farmsteads facing (above) south; (below) east.

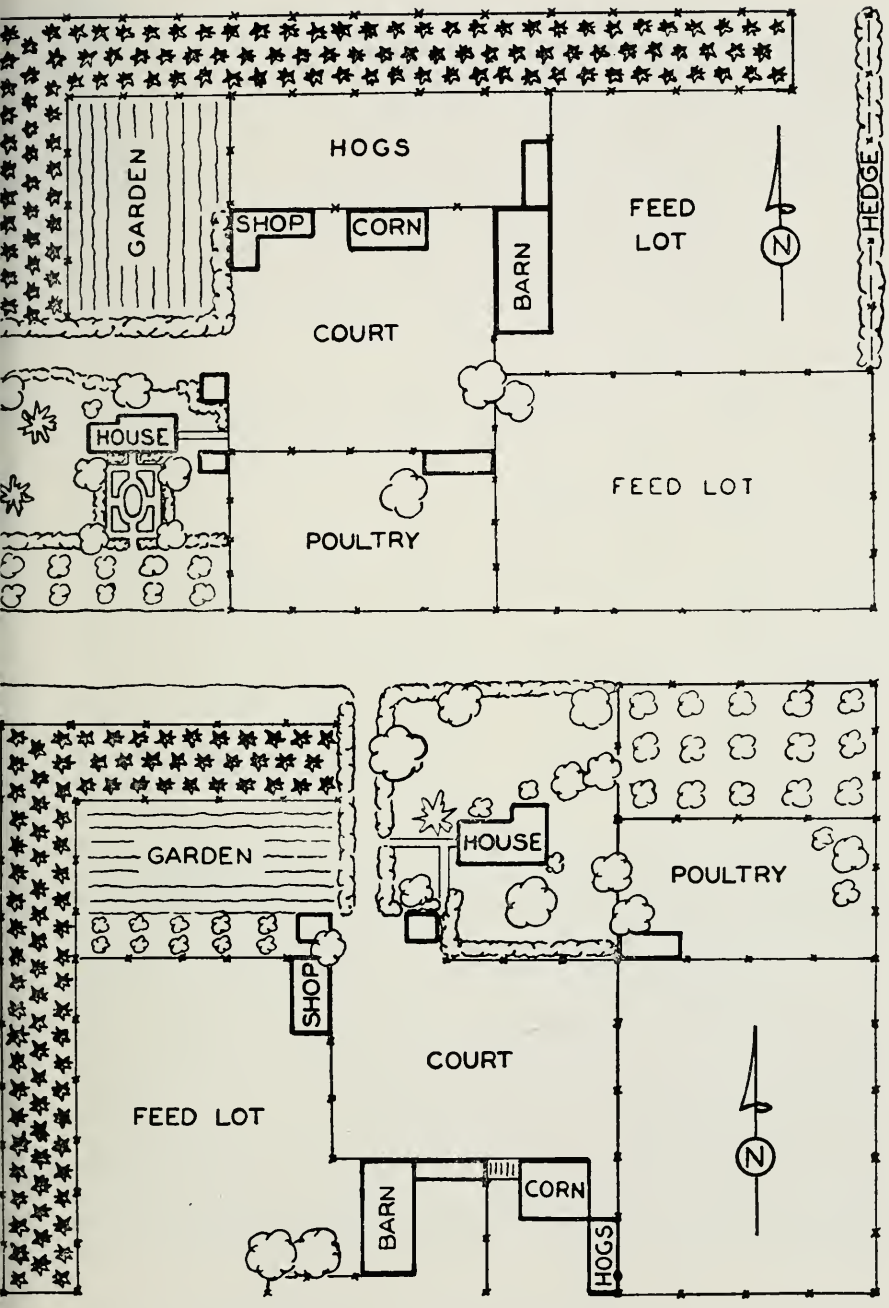

Fig. 10.—Plan for windbreak on farmsteads facing (above) west; (below) north.

present more difficult problems because of the necessity for shutting out completely the front outlook of the house, if the best protection is to be realized. Most Illinois farm homes are built so close to the road that there is not room enough to plant a solid windbreak between the front of the house and the road. Usually, in instances where homes face west or north, it is necessary to

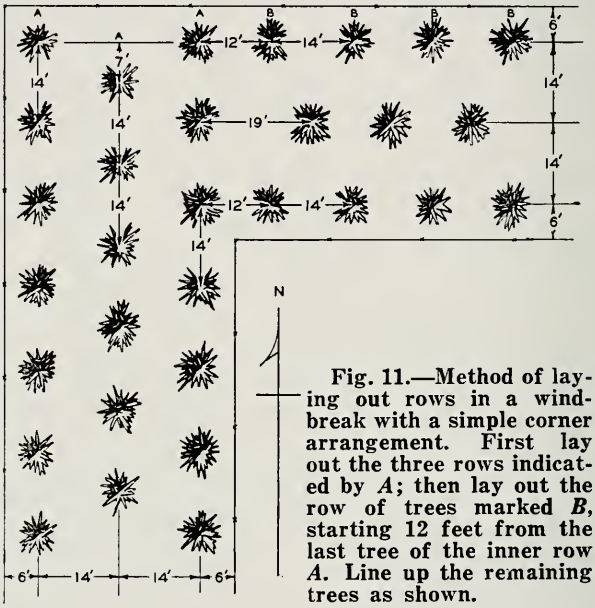

Fig. 11.—Method of laying out rows in a windbreak with a simple corner arrangement. First lay out the three rows indicated by *A*; then lay out the row of trees marked *B*, starting 12 feet from the last tree of the inner row *A*. Line up the remaining trees as shown.

sacrifice part of the efficiency of the windbreak and part of the view, and make the short leg of the L only a single row of trees extending whatever distance is desired across the front of the property.

If a farmstead faces north or west, and it is desired not to obstruct the view at all from the front of the house, the windbreak can then take only the form of a single strip running along the north or west side of the farmstead.

Distances From Buildings.—Effective protection is afforded by a good windbreak to a distance approximately eight times its height. Thus, a windbreak 40 feet high should almost completely check the wind for 320 feet to leeward, and buildings and lots in this area should have adequate protection. Some influence of the windbreak may be felt at a distance up to 20 times the height of the trees, but in Illinois it is best to keep principal buildings within a 300-foot distance.

To prevent dead-air pockets around buildings in summer, and to minimize the piling of snow on buildings and walks in winter, the windbreak should be set not closer than 50 feet from buildings, and 100 feet is a better distance if room is available. Where possible, the end of the windbreak should extend at least 50 feet past the line of the last building to be protected.

Number of Rows and Spacing.—For the species of evergreens recommended for use, the best type of windbreak consists of three rows of trees, the trees in the middle row being alternated with those in the two outside rows, fig. 11. The rows should be at least 14 feet apart and the trees should be spaced 14 feet apart in the rows. At this spacing, with three rows being used, three trees are required for every 14 feet of windbreak; the planting rate is one tree per 4.7 feet. At this rate, a 600-foot windbreak will require 128 trees. An easy way to estimate the approximate number of trees required is to multiply the windbreak length in feet by 0.22. As estimated by this method, the number of trees required for a 600-foot windbreak is 132.

Trees should not be planted close together to form a hedge, fig. 12, for evergreens need plenty of room and light to develop dense lower branches, and the lower branches are needed to check surface winds when the trees start making good height growth.

Fig. 12.—A well-spaced windbreak being planted in De Kalb County. The trees were trucked from the nursery on the planting day and were out of the ground only a few hours.

To avoid difficulties in laying out the corner of the windbreak, follow the plan shown in fig. 11. First stake out one strip of the windbreak *for its entire length,* the three rows indicated by *A*. Then lay out the outer row of the second strip, the trees indicated by *B*, in line with the trees nearest the letter *A* in the outside rows of the first strip. In staking out the first row in the second strip, begin 12 feet from the nearest tree in the inside row of the first strip. The middle row of the second strip will then start 19 feet from the inside row of the first strip.

Species of Trees to Use.—Evergreen trees provide the most satisfactory windbreak because they hold their foliage during the winter months when protection is most needed. The spruces and firs form an almost solid barrier to the wind because of their dense-branching habit and their tendency, if given plenty of growing room, to hold heavy foliage on branches close to the ground, fig. 2, page 3. Of this group the Norway spruce and the Douglasfir are best adapted to Illinois conditions. Norway spruce is suited to the northern two-thirds of the state. Douglasfir, from the dry Rocky Mountain region, is more drought resistant and is adapted to a wider range of soils.

Pines make more rapid height growth than spruce or fir, but, because their branching habit is more open and their foliage thinner, they do not break the wind so effectively. For height in a windbreak at an early date, pines may be used as a center row between two outer rows of spruce or fir. Pines should not be used alone, except on light, sandy soils to which the other trees are not adapted. Five pines—red (Norway) pine, eastern white pine, loblolly pine, shortleaf pine, and Austrian pine—may be used for windbreaks. The shortleaf pine is a southern tree, native to lower Illinois, and should be used only in the southern third of the state. Loblolly pine, another southern species, may be planted as far north as East St. Louis, Salem, and Lawrenceville. The other three pines may be used throughout Illinois.

Another evergreen, the eastern redcedar, is occasionally used for windbreaks. It has very dense foliage and is pleasing in appearance, but it is comparatively short and slow growing, and it harbors the cedar-apple rust. See page 32.

It is advisable to use more than one species of tree in the windbreak to prevent the severe appearance of straight rows of trees all of the same form and color, and to make the windbreak blend into the farmstead landscape scheme. Norway spruce or Douglasfir or both may be used for the foundation of the wind-

break, but the solid rows should be broken with small groups of evergreens having foliage of different texture, color, and form. Such groups at the ends and in corners are particularly pleasing in appearance. The windbreak spacing is not changed; the other varieties simply replace the spruce or fir in the regular spacing. Some trees that may be used in this way without lessening the effectiveness of the windbreak are Colorado (blue) spruce, white spruce, Black Hills spruce, concolor fir, red pine, Austrian pine, and Scotch pine.

Selection of Planting Stock.—A careful selection of planting stock contributes much to high survival the first season and

Fig. 13.—Balled-and-burlapped tree of size recommended for windbreak planting. This tree has a ball of earth large enough to insure its being handled without disturbance to the root system. Quickest results may be expected from balled-and-burlapped stock.

favorable growth and development in the following years. Trees with dense, vigorous foliage and compact systems of fine, fibrous roots offer better chances for success than do those with spindly tops, thin or yellowish foliage, and weak root systems. Thrift and vigor, reflected in the appearance of the foliage, determine the inherent ability of the tree to withstand the shock of being transplanted.

"Bargain" trees should be avoided. Usually in such stock some quality desirable in good trees is lacking. Perhaps the stock is weak and poorly developed because of crowding in the

nursery row. It may have been damaged by severe weather that has seriously lowered the vitality of the trees. Possibly the trees are too large for safe transplanting, or they may have been growing too long without the benefit of root-pruning. Spruce or fir that has grown for more than 4 years without being root-pruned develops long, spreading roots that must be cut off in digging. Such loss of roots proportionately reduces the chances for survival and later growth.

Quickest results and greatest early success may be expected from balled-and-burlapped stock, fig. 13. Balled-and-burlapped trees are those that have been dug with a ball of earth on the roots and this ball wrapped securely in burlap. Trees dug in this manner never have the roots exposed to the air, and, if they are carefully handled, the soil does not become loosened from the fine feeding roots. In this class of stock, trees with 2- to 4-foot tops are considered most economical and also most convenient to handle. If larger trees are used, their height should not exceed 6 feet, and then the ball of earth should be large enough to include a high proportion of the roots.

Trees that have balls of earth too small to include most of the roots should be rejected. Balls of earth that are too small will show numerous ends of freshly cut roots, shorn off in digging. Narrow-crowned trees that give evidence of having been crowded in the nursery should be similarly rejected.

Balled-and-burlapped trees should be used, if finances will permit. Other factors being equal, losses are considerably less in balled-and-burlapped stock than in bare-root stock.

If low cost is an important consideration, however, bare-root stock may be used. Bare-root trees are those that have had the soil shaken from the roots, which are then kept moist by being packed in wet moss or similar material. Because of the unavoidable loss of some roots in this type of handling, it is essential that the root system consist of a mass of fine, fibrous roots, fig. 14, rather than a few coarse, stout ones. In bare-root trees, the qualities of thrift and vigor and dense, well-balanced tops and roots are even more important than in balled-and-burlapped trees.

Bare-root trees should be transplants at least 5 years old. Those with 12- to 15-inch tops have proved most successful, and the height should never exceed 18 inches. Planters have experienced severe losses with bare-root stock of larger size. If transplants smaller than 12 inches in height are used, severe damage by rabbits may result. (See "Protection," page 26.) Trans-

Fig. 14.—A bare-root Norway spruce with fine, fibrous roots. A root system of this kind and a top of 12 to 15 inches are important for success with bare-root stock.

plants designated as 2–3 stock have been grown 2 years in the seedbed and 3 years in transplant rows; 2–2–1 stock consists of trees grown in the seedbed for 2 years and in transplant rows for 2 years followed by 1 year in rows after a second transplanting. Transplanting has a root-pruning effect and aids in the development of compact, fibrous root systems. In selecting bare-root trees it should be realized that sharp attention is necessary in handling and care to assure satisfactory results.

Windbreaks generally require 100 to 150 trees, varying, of course, with the length necessary to protect buildings and lots. (See "Number of Rows and Spacing," page 11; also "Replanting," page 26.) It is advisable to purchase at least 10 more trees than are actually needed for the original windbreak planting, so that some extra trees may be planted in the garden and used later to replace losses in the windbreak.

The majority of ornamental nurseries grow the types of trees satisfactory for windbreaks, and some of the large nurseries specialize in producing windbreak trees. Information on sources and prices of windbreak planting stock may be obtained by writing to the Extension Forester, 219 Mumford Hall, Urbana, Illinois.

Because farmstead windbreaks have ornamental value, trees for planting them are not available from Illinois state nurseries, which supply stocks for shelterbelts (field windbreaks) and for the establishment of forest plantations in which wood crops are grown and produced.

Trees should be ordered early in the winter to assure obtaining those desired before supplies run out.

PLANTING THE WINDBREAK

Preparation for Planting.—All plans for the windbreak should be made in the fall, and the area should be marked out. Included in the area should be a strip at least 6 feet wide between each outer row and a fence that should be erected to protect the trees, figs. 11 and 21. An 8-foot strip between the trees and the fence is advisable where space permits, since this distance allows more room for mowing equipment, and the trees are larger in size and better established by the time their branches reach the fence. Experience in Illinois indicates that it is advisable to maintain a sod cover on the windbreak area; so soil preparation will be necessary only where a satisfactory sod does not

Fig. 15.—Drainage from barnyards kills evergreen trees. This section of windbreak area is part of the short strip shown in fig. 8, 10 years after being planted. Note dead trees, thin foliage, and lack of good stand.

already exist. Where plowing of the windbreak area is essential, this work should be done thoroughly in the fall and followed by disking and harrowing in the spring.

Since windbreaks are located to protect barns and feedlots, as well as houses, there may often be drainage of barnyard water across the windbreak area. Such drainage, and even slow seepage, will kill evergreens in a short time and should be taken care of before the trees are planted, figs. 15 and 16. The local situation will, in most cases, dictate the manner of meeting this problem. Where the natural surface drainage across the windbreak area is well defined, a ditch or tile may be most practical. Usually, seepage in level or nearly level situations can be prevented by forming a ridge 2 or 3 feet high between the lot and the windbreak on the windbreak side of the fence. Improvement of drainage in another direction may also be necessary. In some cases where a pronounced even slope would carry lot drainage across the windbreak area, it might be advisable to provide a catch basin by laying a tile line between the lot and the windbreak

on the windbreak side of the fence and filling from tile to ground surface with crushed rock. It is preferable to carry barnyard water around the windbreak by a diversion ditch where that method is at all practicable.

It is advisable to build necessary fences around the windbreak area in the fall rather than to postpone this job until the

Fig. 16.—These vigorous Norway spruce trees are located in the same windbreak as those shown in fig. 15. Absence of manure water accounts for the difference in growth and survival rate. The stand here, not exposed to barnyard drainage, is already giving protection, 10 years after being planted.

trees are planted, when the fencing might be neglected because of the rush of spring work. The fence must be adequate to keep out both stock and poultry.

Only spring planting of windbreaks is recommended. Spring-planted trees have the advantage of one growing season before they encounter the rigors of their first winter. Fall-planted windbreaks may suffer heavy losses from frost heaving or winter burning, and the average farmstead owner cannot afford to lose a large number of trees of the size used for windbreak planting.

In the spring each row should be laid out and the place for each tree marked with a stake. Laths make handy markers for this use, fig. 17. It is important that the area be ready so that planting may be done without delay as soon as the trees are received.

Handling the Trees.—Arrangements can be made to have nurseries ship your trees, have them ready to be called for, or deliver them at the time you request. When your order is con-

firmed, you should notify the nursery of a date that will bring you the trees at a time when in your experience you may expect the ground to be in good condition; the earlier in the spring the better.

Balled-and-burlapped trees should be moved to the farm and planted in the shortest time practicable after being dug at the nursery. The greatest danger of damage through drying exists in this period. Trucking is generally the most satisfactory means of transportation, since it is usually the most prompt and economical. Some windbreak planters in areas 125 to 150 miles from

Fig. 17.—Windbreak area in Putnam County that has been well prepared and made ready for the trees. Lath stakes indicate where the trees are to be planted.

nurseries of their choice in the Chicago area have used return trips of livestock trucks in transporting their trees. Freight is too slow for such a perishable product as nursery stock, and, because of the weight of balled-and-burlapped trees, express is usually not economical. In transit the balls of earth should be kept moist with wet sacks or straw, or the trees should be protected with a tarpaulin so that wind and sun will not dry them out.

Use care in handling the trees. Dropping or other rough handling breaks the ball of earth and tears away fine feeding roots; such handling also loosens the soil, which can then dry out quickly. Trees should be picked up by the ball and not by the stem. Lifting by the stem places an excessive strain on the

root system and tears the fine roots, particularly if the ball of earth is large and heavy.

When temporary storage becomes necessary, balled-and-burlapped trees should be grouped together in a shady place, as on the north side of a building or in a cool shed. The balls of earth should be packed with wet sacks or the trees protected with a tarpaulin to reduce evaporation.

Rapid transportation of bare-root trees is important, and both express and truck shipments have proved satisfactory. However, if your trees are to be shipped by express, telephone your express office daily after receiving notice of shipment so that you can call for the trees as soon as possible after their arrival. Bare-root trees of the size suitable for windbreak planting are usually tied in bunches and packed tightly in crates or burlap-covered bundles with the roots in moist moss. The moss is necessary to keep the tree roots moist, but if left very long it will heat and mold, seriously damaging the trees. It is therefore urgent that you remove the trees promptly from the transportation office and plant them or heel them in the same day in a cool, shady place.

To heel-in trees, make a trench of sufficient depth, width, and length to accommodate the roots when the trees are placed side by side in a single row. Dig the trench with one side of it slightly sloping; when removing the soil pile it on the other side so that you can easily throw it over the roots after you have placed them in the trench. Before opening a bunch of trees, cut off any long, straggling roots, as roots curled up in the bottom of the planting hole or turned back toward the top cannot grow properly. After pruning the straggling roots, open the bundle and spread three to five trees along the sloping side of the trench; immediately cover the roots with moist soil and firm it about them.

Keep the bundles of trees in the moist moss of the package until the trench is prepared. *Use care at all times to keep the roots of the trees moist.* Drying of the roots will kill them; it is improper handling of the trees that causes many serious plantation losses. After heeling-in the trees, water the soil about the roots and keep it well watered until the trees have been planted. If you have not heeled-in the trees in a shady place, shade them with boards or burlap set high enough off the ground to allow free circulation of air around the tree tops. You can safely keep the trees heeled-in for a week or 10 days, but you can expect

best results if you plant them in the windbreak area at once. When you remove trees from the heeling-in bed, be sure to loosen the soil around the roots so that the fine ones will not be torn away. These fine roots are important to the survival of the trees.

When planting bare-root trees, carry them in a galvanized bucket or tub containing sufficient water to cover the roots. The water will serve to keep the roots moist while the trees are being carried along the rows. Take trees from the bucket one at a time; keep each tree in the bucket until the hole for it is prepared. The exposure that results from carrying bare-root trees in your hand along the planting row for even a few seconds will kill the fine roots.

Planting.—Where a sod cover exists on the windbreak site, it is necessary to cut away an area of sod at least 4 feet in diameter where each tree is to be planted. The hole in which the tree is planted should be wide enough and deep enough to accommodate the ball of earth without crowding, or to receive the roots well spread out in a natural position, and to allow the tree to be set at least as deep as it grew in the nursery. Planting the tree as much as an inch deeper than it grew in the nursery will do no harm, but it should never be planted any shallower.

A grub hoe, spade, or round-pointed shovel may be used to cut away sod. Holes may be dug with a round-pointed shovel, or they may be dug to desired hole depth with a powered post-hole auger and enlarged to proper size with shovel or spade.

Immediately after each hole is dug, select a tree, and plant it in the hole. *Avoid digging holes in advance of planting,* because holes dry rapidly under average spring weather conditions. Dry soil, as well as air, in contact with the roots can damage and possibly kill the tree. Moist soil in the hole is essential for bare-root stock and desirable for balled-and-burlapped trees. In planting a balled-and-burlapped tree, set the ball in the hole *without removing the burlap,* fig. 18, and tamp top soil around the ball until the hole is filled within an inch or two of the top. A small-diameter post tamp is useful in packing the soil around the curved bottom of the ball as well as the sides. In planting a bare-root tree, hold the tree in an upright position and work fine soil down around the roots, tamping it in firmly until the hole is about three-quarters filled. In the planting of either balled-and-burlapped or bare-root stock the soil should be packed firm; loose soil or air pockets are to be avoided. Extreme

Fig. 18.—Balled-and-burlapped Norway spruce set in windbreak row without removing burlap from ball of earth. The cords will be cut and the burlap turned back from the top of the ball before the hole is completely filed with soil.

Fig. 19.—Watering newly planted Norway spruce after the hole has been filled within an inch or two of top with soil. After the water has soaked in, the hole will be filled level with the ground surface with loose soil.

care is necessary in handling bare-root trees to assure satisfactory results.

Before completely filling the hole of the balled-and-burlapped or the bare-root tree, pour in at least one bucket of water and let it soak in, fig. 19. Do no more tamping after watering. Fill the hole to the ground surface with loose soil; do not make a mound around the base of the tree. In planting a balled-and-burlapped tree, before the hole is completely filled with soil, loosen the burlap from the top of the ball and spread it out to be covered with a mulching material. Cut cord or twine that may be tied around the stem of the tree.

When planting windbreak trees, observe these precautions:

Keep tree roots or ball of earth moist.

Dig the hole deep enough to avoid curling or bunching of the roots.

Set the tree in an erect position.

Set the tree at least as deep as it grew in the nursery, and not more than 1 inch deeper.

Keep dry soil, sod, or other debris out of the hole.

Use only moist soil in filling the hole.

Pack soil around the tree roots or ball of earth.

Settle the soil with a bucket of water.

CARE OF THE WINDBREAK

Mulching.—A good mulch should be placed around the trees immediately after planting and this mulch should be maintained until the lower branches of the trees cover the area normally covered by the mulch. The importance of such a mulch cannot be overemphasized. Experiences of windbreak planters clearly show that an effective mulch pays valuable dividends in higher survival, denser foliage, and more rapid growth. In summer it keeps grass and weeds away from the tree and conserves moisture for the shallow feeding roots; in winter it keeps the soil at a relatively even temperature that assures minimum winter injury.

Peat moss, chopped hay, straw, or ground cobs make good mulching material. Straw is frequently used, as it is usually available and is easy to handle, fig. 20. Any straw used should not contain animal manure. Although thoroughly rotted manure may be used effectively, *the high nitrogen content of manures usually available on farms burns the tree roots* and makes use of such materials dangerous.

In recent years ground corn cobs have increased in popularity as a mulch. The material is easy to apply and keep in place in spring winds; also it does not rot down so fast as straw and requires less frequent replacement. Under average conditions a

Fig. 20.—Straw mulch placed around this Douglasfir has been completely effective in keeping weeds and grass away from the tree.

liberal application of ground cobs will be effective for two summers, whereas a similar application of straw will need replacement after one season. Cobs should be ground to the fineness commonly used in poultry brooder houses. Broken cobs from corn shelling, because of their coarseness, are not effective.

Sawdust and fine, chaffy materials are not entirely satisfactory because of their tendency to crack with the soil in dry periods.

The mulch should cover an area not less than 4 feet in diameter and should be at least 3 inches thick. The mulching material should not be placed against the tree; a 2- or 3-inch clearance should be provided around the stem to reduce the possibility of mouse injury. As soon as the mulch breaks down so that weeds start growing through, it should be replaced.

Sod Cover or Cultivation?—Establishing a good sod cover between the trees and maintaining a good mulch around the trees

have been found much more satisfactory practices than cultivating the windbreak close to the trees.

In case farmstead owners desire to grow garden crops in the windbreak area, cultivation is not objectionable if kept far enough away from the trees to avoid disturbing the roots and mulch. Any row crops may be grown, but vining crops should be avoided. The cultivation of garden crops in the windbreak should not be carried on for more than 3 years after the trees are planted, as the roots of the trees will begin to spread out where they will be liable to injury by the cultivator.

In establishing a sod cover, use any grass mixture suited to the locality. Mixtures including alsike clover or lespedeza are desirable; *sweet clover and alfalfa should be avoided.* A suitable mixture includes timothy, redtop, and alsike clover. In parts of the state where it reseeds, lespedeza may be added. After the sod is established, usually about two clippings a season are advisable to reduce competition with the trees. Clipping should occur before the growth becomes rank and develops heads.

Fig. 21.—The fence is important in windbreak planting. This young windbreak in Vermilion County is protected from livestock by good fence.

Protection.—Windbreaks, to be successful, must be protected throughout their entire lives from both stock and poultry. As stated above, adequate fences, fig. 21, should be built *even before the trees are planted and thereafter permanently maintained.*

Animals pack the soil and injure tree roots; they browse and trample small trees and spoil the effectiveness of larger trees by browsing the foliage and by breaking the lower branches, fig. 22. Poultry scratch earth away from the roots, fig. 23, and

Fig. 22.—A Norway spruce in windbreak damaged by sheep. Note hanging wool (circle) and stub of branch (arrow) broken by rubbing. Absence of low branches permits ground wind to whip under the green crowns and reduce effectiveness of the windbreak. All forms of livestock should be permanently excluded from the windbreak area.

pick the opening buds in the spring; when they roost in the trees their droppings kill the branches. Both stock and poultry destroy the mulch applied after planting, as well as the carpet of needles that later naturally forms and provides mulching benefits. Fifteen- to 20-foot trees have been observed losing needles and becoming thin-foliaged as a result of the scratching and dusting of poultry beneath their crowns. In some situations where small trees are used, protection from rabbits may be necessary, but usually no special protection from these animals is required if the fence is poultry tight.

Replanting.—The success of a windbreak depends on a solid stand of trees being brought through to maturity. Each tree

missing from the original pattern cuts down the efficiency of the windbreak and lessens the planter's reward for his efforts in setting and caring for the trees. The planter cannot expect every tree to live, and, as there are usually a few losses during the first

Fig. 23.—Poultry scratched soil away from this Douglasfir and exposed fine, shallow feeding roots. Note absence of mulch around the tree and of vegetation in the foreground. Protection from poultry is essential to good windbreak development.

few years, it is advisable to order at least 10 more trees than will actually be needed to plant the windbreak. These trees should be set about 3 feet apart in a row in the garden, cared for as are the windbreak trees, and used to replace the windbreak trees that die. There should be no further losses in the young windbreak after it is 5 years old, and any remaining replacement trees may be used for ornamental planting about the grounds.

Renewing Old Windbreaks.—Evergreen trees, like other plants, will not live forever, and the time must be expected to arrive when the trees in the mature windbreak will start dying. Then the windbreak will begin to lose its effectiveness. Many of the old windbreaks planted in northern Illinois in the 1860's and '70's have served well for many decades but are now becoming thin and ineffective, as is shown clearly in fig. 24. The life span of the evergreens is usually longer in northern Illinois than in the southern or central parts of the state, and on the Grand

Fig. 24.—A Norway spruce windbreak, 65 years old and beginning to thin out; this windbreak is badly in need of supplemental planting.

Prairie their life span is shortest. The windbreaks planted today, however, should last much longer than the old windbreaks have lasted, because in the early plantings the trees were invariably set too close together and their greatest loss was the result of overcrowding.

As soon as the old windbreak starts thinning out, steps should be taken to get new trees established so that these trees will be tall enough to be effective by the time the old trees have to be removed. The best plan is to start two new rows of trees outside the old windbreak, as was done in the case illustrated

Fig. 25.—Two new rows of Norway spruce planted to supplement an old windbreak that is thinning out. When the old windbreak is gone, a third row can be set where the old trees now stand.

in fig. 25. When the old trees finally have to be cut, a third row of new trees may be set where the old windbreak originally stood. If it is desired to work the windbreak in closer to the farmstead, the first two rows of new trees can be set on the inside of the old windbreak rather than on the outside. New trees should never be planted among the old ones, for the evergreens need full light for their development and will be quickly killed by the shade from the old trees.

Diseases and Insects.—The trees in the windbreak should be watched for symptoms of injury by disease or insects, for such injury may seriously retard the growth of the trees, or even kill some of them. Red spider and bagworm are rather common pests that may attack individuals or small groups of the kinds of trees recommended for windbreak planting in Illinois. Alertness in detecting an attack is important to avoid loss; controls properly timed are simple. (See University of Illinois College of Agriculture Extension Circular 509, *Protecting Shade Trees From Insect Damage.*) No control has yet been developed for the tip moth, which attacks shortleaf pine, or the Zimmerman pine moth, which damages Austrian and Scotch pines.

A disease known as Cytospora canker has been found in a few instances on young Norway spruce; apparently it had spread from old spruce near-by. Recent occurrence of white pine blister rust on eastern white pine in northern Illinois may make the planting of that species in windbreaks unadvisable except in locations (usually on the prairie) where cultivated and wild gooseberries and currants, alternate hosts of the disease, do not usually grow. Gooseberries and currants that grow within 900 feet of the white pine location should be destroyed.

It is advisable to look over the trees occasionally and, whenever any symptoms of disease or unidentified insect injury appear, immediately send specimens of the injured branches to the Natural History Survey, at Urbana, for identification and recommendations for control measures. Quick action may save considerable loss.

WHAT THE WINDBREAK TREES ARE LIKE

Norway Spruce *(Picea abies).*—A native of Europe that has been found well adapted to planting in North America. Makes good growth throughout most of the state of Illinois but will not develop on sandy or excessively dry soils. Develops a tall, conical

crown with the branches tending to sweep downward and then turn slightly upward at the ends. The twigs often hang down like streamers from the lower branches, fig. 26. The leaves are short, needle-like and rich dark green. Grows best on deep, fresh soils. See figs. 2, 3, 4, 16, and 27, as well as fig. 26.

Douglasfir *(Pseudotsuga taxifolia)*.—A native of western North America found growing under a wide variety of conditions. The type found growing in the dry central Rocky Mountain region is well adapted to planting in Illinois. It is somewhat drought resistant and much less susceptible to red spider damage than is Norway spruce. Develops a dense, pyramidal crown, with lower branches sweeping downward; similar to the Norway spruce. The densely leaved twigs, also, sweep downward from the branches, giving an exceptionally attractive appearance to the tree. The leaves are needle-like, averaging 1 inch in length, and, although normally dark green, they often have a blue tinge. Early growth is at about the same rate as for Norway spruce. A few cases of late spring frost damage have been seen.

Fig. 26.—Interior of Norway spruce windbreak, showing density of foliage. The trees in this windbreak in southern Hamilton County averaged 30 feet in height growth in 18 years; they illustrate the adaptability of Norway spruce to southern Illinois.

White Spruce *(Picea glauca)*.—A native tree of the north woods of the Great Lakes region, northeastern United States, and Canada that has been used successfully in ornamental plantings in Illinois. It does not grow so fast as Douglasfir or Norway spruce, but it has a dense, bluish-green foliage that is useful for windbreak plantings and that gives pleasing ornamental effects. Black Hills spruce *(Picea glauca densata)* is a variety of white spruce from the Black Hills of South Dakota. This variety is exceptionally drought resistant, but it grows too slowly to be generally recommended for windbreak planting in Illinois.

Colorado (Blue) Spruce *(Picea pungens)*.—A native of the Rocky Mountains well adapted to Illinois conditions. Highly de-

sirable in the blue forms as an ornamental tree because of the light bluish cast and denseness of the foliage. Drought resistant, but slow growing. An excellent tree to mix with Douglasfir or Norway spruce for pleasing landscaping effects.

White (Concolor) Fir *(Abies concolor).*—A true fir native to western North America and successfully planted as an ornamental tree in Illinois. The dense, bluish-green foliage and the stocky, pyramidal form of the crown make it highly attractive as an occasional tree in mixture with Norway spruce or Douglasfir. High cost usually makes its extensive use prohibitive.

Red (Norway) Pine *(Pinus resinosa).*—A native tree of the forests of the Great Lakes region and northeastern United States that is doing exceptionally well in plantations in Illinois, even on dry, sandy soils. Makes rapid growth and attains good height. The reddish color of the bark and the sturdy, upright form of this tree add to the beauty of an evergreen planting. The needle-like leaves are long, but, being borne in clusters of two leaves each, do not make such dense foliage as spruce or fir. This, as well as the other pines, may be planted as the center row of a spruce or fir windbreak for more rapid height growth in the early years of the windbreak. However, it should not be planted alone except in the sand regions where conditions are too dry for spruce or fir. Although red pine is quite free from insect pests and diseases, on slowly drained soils it dies at an early age.

Eastern White Pine *(Pinus strobus).*—A native tree of northern Illinois commonly found as a dooryard tree throughout the state. Well adapted to a wide variety of soils, but will not stand dry conditions so well as red pine or Austrian pine. This tree makes comparatively fast growth and reaches greater height than the other evergreens, except on the Grand Prairie, where the top tends to flatten out. The dark green, needle-like leaves, borne five in a cluster, are fine and limber, and form a denser foliage than that of the shortleaf, Austrian, or red pines. It may become infected by the white pine blister rust where that disease occurs on near-by currants and gooseberries. See discussion, "Diseases and Insects," page 29.

Shortleaf Pine *(Pinus echinata).*—A native pine of southern Illinois found on the dry ridges of the Ozarks. Grows rapidly and is well adapted to planting in poor, dry soils. The needle-like leaves, borne two or three in a cluster, do not make a dense foliage. This tree is useful principally because of its rapid growth, but should be planted only in the southern part of the state.

Loblolly Pine *(Pinus taeda).*—A native of southern United States that has grown very rapidly in southern Illinois since its introduction there about two decades ago. Adapted to moist soils, it should not be planted in poor, dry situations. The bright green, needle-like leaves, occurring in clusters of two and three, fail to provide dense foliage. This tree, sometimes attacked by sapsuckers, should be used only south of an east-west line between East St. Louis and Lawrenceville.

Austrian Pine *(Pinus nigra).*—A native of Europe that was widely planted in Illinois as a dooryard tree in the late years of the last century. The needle-like leaves are long and dark green, and form a fairly dense foliage. It makes rapid growth and will develop on poor, dry soils. It is a preferred host of the Zimmerman pine moth and subject to attack by sapsuckers. Its value in a windbreak is somewhat inferior to that of red pine.

Eastern Redcedar *(Juniperus virginiana).*—A native evergreen of Illinois with short, needle-like and scalelike leaves, and a very dense branching habit. It does not make great height growth, seldom reaching a height of 40 feet, but is adapted to practically all soils. Because of its dense crown, it is useful where there is room for only a single row of trees. The redcedar harbors the cedar-apple rust, which may cause serious damage to its alternate host, the apple. It is therefore not recommended for use in apple regions, even though orchardists may grow rust-resistant varieties of apples. See fig. 27 for windbreak of redcedar and Norway spruce. The average growth rate of the eastern redcedar is slow.

WINDBREAKS AND WILDLIFE*

The usefulness of evergreen windbreaks to wildlife begins soon after planting and lasts throughout the life of the trees. Such usefulness may be perpetuated by replanting, as discussed on pages 26 to 29 of this circular. During the first few years the planting area may supply good nesting cover for game and certain ground-frequenting songbirds. As the trees become larger they become increasingly valuable to tree-nesting birds, including mourning doves. Squirrels make use of larger windbreaks, especially if suitable nest boxes are provided.

Windbreaks supply dense, close-to-the-ground cover, particularly valuable in winter in protecting wildlife during periods

*This section by Lee E. Yeager, formerly Forester, Illinois Natural History Survey.

of deep snow and very cold weather. They offer this sort of cover for a much longer time than do regular forest plantations because the trees, spaced farther apart, allow the development of low, spreading branches that are not quickly killed by shading. The open spaces between trees are inviting to many native birds. Spruce, eastern redcedar, and fir are somewhat more valuable than the pines for cover purposes.

Windbreaks in the vicinity of farm buildings serve songbirds probably more than they do quails, pheasants, rabbits, or squirrels. No situations are more attractive to wintering birds than those provided by evergreen trees. Bluejays, brown creepers, nuthatches, cardinals, native sparrows, woodpeckers, and other birds flock to such winter quarters. Quails and pheasants take shelter here during severe weather and they may use the cover at other seasons.

Fig. 27.—Eastern redcedar and Norway spruce combined in a windbreak. The two kinds of trees are the same age, but the Norway spruce in the background is twice as tall as the redcedar in front.

Windbreaks make the best possible locations for winter bird feeding stations. The erection of suitable nest boxes after the trees reach a height of 12 to 15 feet may attract the useful screech owl, sparrow hawk, flicker, and other cavity-nesting birds. On the Illinois prairie, screech owls are year-round residents and they are known to destroy an average of one mouse per day. Sparrow hawks, common only during the late spring, summer, and fall, feed largely on insects, especially grasshoppers, and on mice. Most birds likely to use the windbreak are useful insect eaters; therefore, the windbreak, by attracting birds, has an important bearing on protection of the farm garden.

Few places on the farm will serve the youngsters better as an outdoor laboratory for studying nature and her ways, fig. 4.

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